L Number	Hits	Search Text	DB	Time stamp
4	203	hideo with nakagawa	EPO; JPO; DERWENT; IBM_TDB	2003/05/29 14:32
5	4	(hideo with nakagawa) and (etching or etched) and organic and plasma	EPO; JPO; DERWENT; IBM_TDB	2003/05/29 14:32
6	0	(hideo with nakagawa) and (etching or etched) and organic and plasma	EPO; DERWENT	2003/05/29 14:32
7	1	("20010049150").PN.	USPAT; US-PGPUB	2003/05/29 14:33
8	1	("6451620").PN.	USPAT; US-PGPUB	2003/05/29 14:37
9	3	(("6296701") or ("5756401") or ("4944026")).PN.	USPAT; US-PGPUB	2003/05/29 14:38
10	17897	etching and organic and plasma	USPAT; US-PGPUB	2003/05/29 14:39
11	2441	etching same organic same plasma	USPAT; US-PGPUB	2003/05/29 14:40
12	70	(etching same organic same plasma) and ((sputter or sputtering) with cleaning)	USPAT; US-PGPUB	2003/05/29 16:16
13	53	((etching same organic same plasma) and ((sputter or sputtering) with cleaning)) and @ad<=20010510	USPAT; US-PGPUB	2003/05/29 16:19
15	46	(((etching same organic same plasma) and ((sputter or sputtering) with cleaning)) and @ad<=20010510) and (trench or opening or recess or hole or via)	USPAT; US-PGPUB	2003/05/29 15:32
16	46	((((etching same organic same plasma) and ((sputter or sputtering) with cleaning)) and @ad<=20010510) and (trench or opening or recess or hole or via)) and (chemical or plasma)	USPAT; US-PGPUB	2003/05/29 15:33
17	17	(((((etching same organic same plasma) and ((sputter or sputtering) with cleaning)) and @ad<=20010510) and (trench or opening or recess or hole or via)) and (chemical or plasma)) and (nitrogen with plasma)	USPAT; US-PGPUB	2003/05/29 15:33
20	660	((sputter or sputtering) with cleaning) same (argon or He or Ar)	USPAT; US-PGPUB	2003/05/29 16:26
21	86	(((sputter or sputtering) with cleaning) same (argon or He or Ar)) and (plasma with nitrogen)	USPAT; US-PGPUB	2003/05/29 16:27
22	69	((((sputter or sputtering) with cleaning) same (argon or He or Ar)) and (plasma with nitrogen)) and @ad<=20010510	USPAT; US-PGPUB	2003/05/29 16:19
23	25	(((((sputter or sputtering) with cleaning) same (argon or He or Ar)) and (plasma with nitrogen)) and @ad<=20010510) and (organic or polymer)	USPAT; US-PGPUB	2003/05/29 16:19
24	126	((sputter or sputtering) with cleaning) same (argon or He or Ar)	EPO; JPO; DERWENT; IBM_TDB	2003/05/29 16:26
25	1	(((sputter or sputtering) with cleaning) same (argon or He or Ar)) and (plasma with nitrogen)	EPO; JPO; DERWENT; IBM_TDB	2003/05/29 16:27

US-PAT-NO: 6511575

DOCUMENT-IDENTIFIER: US 6511575 B1

TITLE: Treatment apparatus and method utilizing negative hydrogen ion

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Abstract Text - ABTX (1):

In order to eliminate a contact hole of a semiconductor substrate, a **polymer** dreg after ashing of all inside of a via hole is conducted, or an oxide layer on a barrier metal surface, hydrogen gas is changed to a hydrogen radical, the radical is primarily changed to a negative hydrogen ion, and the ion is introduced onto a wafer arranged in a vacuum container. In this manner, cleaning is done by assisting a negative hydrogen ion having its less generated secondary electrons without imparting plasma damage to an element.

Application Filing Date - AD (1):

19991110

Brief Summary Text - BSTX (12):

Here, in plasma **cleaning** before depositing aluminum, there are known a method for **sputtering** a barrier metal surface using inert gas plasmas such as **argon,** a method for etching a barrier metal surface using plasmas of halogen gas such as chlorine (refer to Japanese Patent Application Laid-Open No. 7-226387), and a method for reducing and eliminating a natural oxide film on a

barrier metal surface using hydrogen plasmas (refer to Japanese Patent Application Laid-Open No. 8-298288).

Detailed Description Text - DETX (64):
According to the aforementioned treatment method of the present invention, while damage due to charging is limited, foreign objects such as a natural oxide films adhering to the conductor surface or **organic** materials such as photo resist residues are eliminated, and the surface can be cleaned.

Detailed Description Text - DETX (71):
FIG. 17 is a sectional view showing a structure of a contact hole in a source drain area for an element formed on a wafer, or a structure of a groove 63 called a "via hole" or "through hole" and a barrier metal 61 to ensure continuity between wires. In this example, after forming a first layer of barrier metal 61 an insulation film 62 is deposited on which a photo resist pattern is formed and etching for forming the groove 63 is carried out. Then, a resist is eliminated by ashing. The surface SF of the barrier metal 61 is covered with a thin oxide layer by being exposed to an oxygen atmosphere such as air between the steps of forming the barrier metal 61 and post-etching, and being exposed to oxygen plasmas in the ashing step. Further, a **polymer** is deposited on the surface SF of the barrier metal 61 on the side wall and bottom of the groove during etching, and the **polymer** may not be sufficiently eliminated in the subsequent ashing step, and a **polymer** dreg RS may remain.

Detailed Description Text - DETX (73):
Thus, before depositing the wiring material, a surface oxide layer is eliminated by a physical **cleaning** (eliminating) method using **Argon sputtering,** a chemical **cleaning** method using chloride trifluoride, or a reactive plasmas **cleaning** method using halogen based gas and plasmas.

Detailed Description Text - DETX (121):

A gate valve of the reaction chamber 103 is opened, the cleaned substrate via the carrier chamber 108 is conveyed from the reaction chamber 103 into the reaction chamber 104, and the gate valve of the reaction chamber 104 is closed. **Nitrogen plasma** treatment is carried out in the reaction chamber 104. The inside of the reaction chamber 104 is depressurized to about 13.3 Pa to 133 Pa. and the substrate is heated at 200.degree. C. to 450.degree. C. and maintained. In this reaction chamber, grow electric discharge plasmas of nitrogen gas is generated using a parallel, flat plate shaped electrode. Thus, the barrier metal on the substrate surface is a nitride, and the barrier properties are improved. The gate valve of the chamber 104 is opened, the substrate is conveyed from the reaction chamber 104 to the reaction chamber 106 via the carrier chamber 108 and the substrate is maintained at 160.degree. C. to 450.degree. C. in the chamber 106. Then, DMAH gas and hydrogen gas are introduced, and aluminum is deposited on the barrier metal nitride by the CVD method.

Detailed Description Text - DETX (139):

In FIG. 27, W denotes a silicon substrate, reference numeral 432 denotes an element separation oxide film, reference numeral 433 denotes a gate oxide film, reference numeral 434 denotes a gate electrode, reference numeral 435 denotes a first inter-layer oxide film, reference numeral 436 denotes a first layer metal wire, reference numeral 437 denotes a barrier metal of a first layer metal wire, reference numeral 438 denotes a reflection proof film of a first layer metal wire, 439 denotes a second inter-layer oxide film, reference numeral 440 denotes a via hole formed as a groove by dry etching, NOX denotes an oxide layer with its thin reflection proof film surface, RS denotes a residue of a **polymer** adhered in dry etching for forming a via hole.

Detailed Description Text - DETX (140):

In the via hole 440 on a silicon substrate surface, a crystal defect introduced by a natural oxide film or ion shock during etching or a residue RS

of the **polymer** adhered in dry etching and the like remains. Thus, when a second layer metal wire 440 is formed, a resistance value of the via hole is increased by a natural oxide film, a crystal defect, or impurities, bringing about a circuit delay or a continuity fault of wiring. These residues are removed by cleaning. However, when these residues are taken in air after cleaning treatment, a natural oxide film is formed again on a cleaned surface, and thus, it is desirable to maintain a vacuum between cleaning and the second layer metal wire. A method for manufacturing a semiconductor device that meets this requirement using plasmas is widely used. However, the problem is a charge-up phenomenon associated with plasmas When this cleaning is carried out by a positive ion treatment, a positive charge introduced by plasmas flows a gate electrode 434 through a first layer metal wire 436. Finally, a voltage is applied to a gate oxide film 433 existing between a silicon substrate W and the gate electrode 434. When this voltage reaches a breakdown voltage, the gate oxide film 433 results in electrostatic breakdown. In addition, a fine tunnel current flows the gate oxide film 433 at a destruction voltage or less, thereby significantly degrading the service life.

Detailed Description Text - DETX (154):

In FIG. 28, W denotes a silicon substrate, reference numeral 432 denotes an clement separation oxide film consisting of a silicon heat oxide film, reference numeral 433 denotes a gate oxide film consisting of a silicon heat oxide film of 10 nm in thickness, reference numeral 434 denotes a gate electrode consisting of a polycrystal silicon. Reference numeral 437 denotes a barrier metal, reference numeral 435 denotes a first inter-layer oxide film consisting of a CVD oxide film, reference numeral 440 denotes a contact hole, NOX denotes a barrier metal surface oxide film, and RS denotes a **polymer** dreg.